

## CLAIMS

1. A heat exchange reactor, comprising:

at least one tube bundle comprising a plurality of tubes arranged substantially parallel to a common longitudinal axis and within an external pressure housing, said  
5 bundle comprising first and second ends in respective first fluid communication with at least one first fluid inlet and at least one first fluid outlet, and said external pressure housing comprising at least one second fluid inlet and at least one second fluid outlet;

at least one baffle oriented substantially perpendicular to the longitudinal axis and disposed about said bundle and configured as a manifold to control a flow of said  
10 second fluid;

at least one layer of interior thermal insulation disposed between said bundle and said housing and in fluid communication with said second fluid.

2. The reactor according to Claim 1, further comprising a plurality of said  
15 baffles.

3. The reactor according to Claim 1, wherein said baffle has a planar polygonal shape.

20 4. The reactor according to Claim 1, wherein said baffle has a planar polygonal shape with  $n$  sides and  $n$  corners.

5. The reactor according to Claim 4, wherein  $n$  is 4.

6. The reactor according to Claim 1, wherein said insulation comprises a sealing groove, and wherein a portion of said baffle is mated to said sealing groove.

7. The reactor according to Claim 6, further comprising at least one compliant  
5 sealing material disposed between said sealing groove and said portion of the baffle.

8. The reactor according to Claim 1, wherein the means for holding said tubes is a plurality of holes in said baffle.

10 9. The reactor according to Claim 1, wherein said insulation comprises at least one load-bearing zone, at least one non-load bearing zone, or both.

10. The reactor according to Claim 1, wherein said insulation is load bearing and supports said tube bundle.

15 11. The reactor according to Claim 1, wherein said insulation is non-load bearing.

12. The reactor according to Claim 1, wherein said insulation comprises at  
20 least one insulation material selected from the group consisting of cast, pressed, molded, machined, rigid insulating board, and combinations thereof.

13. The reactor according to Claim 1, further comprising at least one selected from the group consisting of support means, ancillary equipment, heat exchanger

means, burner means, adiabatic reactor means, absorbent means, adsorbent means, plumbing means, and combinations thereof.

14. The reactor according to Claim 1, wherein said insulation comprises at least one parting plane parallel to said tubes and perpendicular to a plane of said baffle.

15. A method for exchanging heat, comprising heating or cooling a first fluid with a second fluid in the heat exchange reactor according to Claim 1.

16. A method of carrying out a reaction, comprising carrying out a reaction in a first fluid while exchanging heat with a second fluid in the heat exchange reactor according to Claim 1.

17. A method for making a heat exchange reactor, comprising:

- (a) preparing at least one tube bundle comprising a plurality of substantially parallel tubes and at least one baffle disposed about said bundle;
- (b) mating a portion of said baffle to at least one sealing groove in a layer of thermal insulation; and
- (c) contacting the insulation with an external pressure housing.

18. A method for making a heat exchange reactor, comprising:

- (a) fabricating an outer housing;
- (b) contacting at least one layer of thermal insulation with the outer housing;

- (c) mating a portion of at least one baffle to at least one sealing groove in the insulation to form an assembly fixture; and
- (d) assembling the tube bundle with the assembly fixture.

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